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NASA TECH BRIEF

Didymium Compound Improves Nickel-Cadmium Cell

The problem: Increasing the ampere-hour capacity of nickel-cadmium cells without affecting their voltage characteristics.

The solution: An acidified solution of didymium nitrate is added to a solution of nickel nitrate conventionally used to impregnate the nickel electrodes.

How it's done: The additive solution is prepared by dissolving 95.5 grams of didymium hydrate (a commercially available mixture of the hydrated oxides of several of the rare earth elements, principally lanthanum and praseodymium) in 35 grams of 80% nitric acid diluted 1:1 with water. The resulting didymium nitrate solution is then mixed with 1310 grams of nickel nitrate hexahydrate and 3 grams of 80% nitric acid. Sufficient distilled water is added to this mixture to form one liter of the nitrate solution used to impregnate the nickel electrodes.

The nickel electrode plaques (78-81% porosity) are placed into a holder and the assembly is heated to 65° to 70°C under vacuum. The nitrate solution at the same temperature is then drawn into the holder and allowed to remain in contact with the nickel plaques for five minutes. At the end of the soaking period, the nitrate solution is removed and the electrodes are dried for 20 to 30 minutes at 60° to 70°C. The electrodes are then immersed in a large excess of warm 25% sodium hydroxide solution to convert the nitrates retained in the plaques to insoluble hydroxides. The electrodes are then washed several times with distilled water and electrochemically cleaned to remove any residual nitrate ions. A thorough washing with distilled water and air-drying at room temperature complete the process.

The impregnated nickel electrodes are placed into cells with cadmium electrodes of standard impregnation and a 31% potassium hydroxide electrolyte. A 100-milliampere charging current is applied for 16 hours, and the cells are discharged at the same current for 8 hours. Testing of the activated electrodes was accomplished by cycling the cells at 100 milliamperes for 10 cycles.

Notes:

1. The ampere-hour capacity of cells with the impregnated nickel electrodes was found to be more than double the theoretical capacity computed from the gain in weight of the nickel electrodes processed with the additive. In making the computation, it was assumed that all of the weight gain of the electrode is due to active nickel hydroxide, and that the nickel undergoes a one-electron change in the cell reaction. Only a slight increase in cell capacity was observed when the electrodes were subjected to more than one impregnation. The voltage characteristics of the cells were found to be unaffected by this process of activating the nickel electrodes. As yet no explanation has been found for the observed increase in cell capacity.

(continued overleaf)

2. The use of nickel electrodes formed by this process should make it possible to produce nickel-cadmium cells of reduced size and weight. Applications of such cells are indicated on aircraft and other vehicles where bulk reduction is important.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10083

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: General Electric Company under contract to Goddard Space Flight Center (GSFC-295)